

REMARKS

The Examiner's Office Action of April 1, 2003 has been received and its contents reviewed. Applicant would like to thank the Examiner for the consideration given to the above-identified application.

By the above actions, claims 1-8 have been cancelled without prejudice or disclaimer to the subject matter disclosed therein, and new claims 9-19 have been added. Accordingly, claims 9-19 are pending for consideration, of which claims 9, 12, 14, 16 and 18 are independent. In view of these actions and the following remarks, reconsideration of this application is now requested.

Referring now to the detailed Office Action, claims 1-8 stand rejected under 35 U.S.C. §103(a) as unpatentable over either one of Hwang (U.S. Patent No. 6,063,529) or Ando et al. (U.S. Patent No. 5,989,759 – hereafter Endo) in combination with one of ordinary skill in the requisite art's ability. In response, claims 1-8 have been canceled.

The arguments provided below are directed to and the newly submitted claims 9-19 with respect to the applied prior art references.

Before discussing the presently claimed invention and the cited prior art references, Applicant is submitting herewith Figs. A-F for the purpose of explaining the presently claimed invention. Fig. A corresponding to Figs. 1A-1D, and Fig. B corresponding to Figs. 4A-4D in the present application. Fig. C corresponding to Figs. 1A-1D, and Fig. D corresponding to Figs. 4A-4D in the present application. Fig. E corresponding to Figs. 1A-1D and 6A, and Fig. F corresponding to Figs. 4A-4D and 6B in the present application.

It will be apparent from the explanation set forth below, as well as from the attached Figs. A-F, that alignment mark A generally corresponds to a first alignment mark recited in the newly added claims, and that alignment mark B generally corresponds to a second alignment mark recited in the newly added claims.

As discussed in page 1 through page 12 of the present specification, in the conventional method, an alignment mark defined in a previous process step has had a different size from an intended pattern to be defined in a photomask used in the next process step. However, as the intended pattern is reduced in size due to integration of circuits, improved overlay accuracy is required.

According to claims 9 and 14 of the present invention, as illustrated in Figs. A-B, the differences of diffraction of light at exposure is suppressed in overlaying the second intended pattern (i.e., element 61 in Fig. B) in the second photomask with the first on-wafer intended pattern (i.e., element 11 in Fig. A), and thereby a shift of the patterns can be reduced. Note that the difference of diffraction is caused by the different size of the line width between the first intended pattern and the second intended pattern.

Specifically, the alignment mark 13b in Fig. A having the same line width as the second intended pattern in the second photomask is defined in the first photomask. By utilizing the alignment mark 13b, the shift caused by the differences of diffraction of light at exposure is suppressed. As a result, overlay accuracy can be obtained.

Moreover, according to claims 10 and 16, and as shown in Figs. C-D, an alignment mark A (i.e., a first alignment mark) and an alignment mark B (i.e., a second alignment mark) are formed on the substrate by using the alignment marks A and B which have a different line width in the first photomask. Due to the differences of diffraction of light at exposure, a relative positional relationship between the on-wafer alignment marks A and B has a shift as compared with that in the first photomask. Based on the shift amount, a correction value at the alignment is calculated, the correction is made in overlaying the second intended pattern in the second photomask with the first on-wafer intended pattern. Thereby, overlay accuracy can be realized.

Furthermore, according to new claims 12 and 18, and as shown in Figs. E-F, an alignment mark A (i.e., a first alignment mark) in the first photomask has the same line width as the first intended pattern in the first photomask, and at the same time an alignment mark B (i.e., a second alignment mark) in the second photomask has the same line width as the second intended pattern in the second photomask. Since the intended pattern and the alignment mark have the same line width, any relative positional shift between the intended pattern and the alignment does not generate in formation of patterns on the substrate. Thus, only the shift by diffraction of light at exposure is corrected in overlaying the alignment A with the alignment B so as to achieve high accuracy correction.

The differences between the presently claimed invention and Hwang and Ando, respectively are set forth below.

As previously submitted in the Amendment filed March 21, 2003, the invention of Hwang relates to an overlay accuracy measurement mark used in measuring an overlay accuracy. Specifically, tetragonal overlaying marks are formed in the layers forming each mask pattern. The invention of Hwang measures the deviation between each mask pattern, as illustrated in Fig. 4. Further, although the overlay patterns, which are to be measured, are formed in the mask pattern and are tetragonal, the size of the patterns are different, as disclosed in, e.g., claim 1, line 9 of Hwang.

On the other hand, the presently claimed invention is for suppressing the alignment shift between the alignment mark used in overlaying and a circuit pattern (herein referred to as the intended pattern) to form the semiconductor device by utilizing diffraction of light at exposure. In the presently claimed invention, the alignment mark has the same line width as the intended pattern to make an effect of diffraction of light same. Thereby, the alignment shift is suppressed. Hence, the presently claimed invention is clearly distinguished over Hwang.

As previously submitted in the Amendment filed March 21, 2003, Ando discloses an invention relating to a lithography system of mix and match method using multiple types of exposing devices during the forming of a single layer mask pattern. Specifically, only light exposure is performed on the surface of the substrate on which a film of photosensitive material is formed, thereby forming a latent image of the pattern in the photosensitive material. Next, the latent image is exposed for pattern alignment, and development is performed after the forming of the mask pattern, as disclosed in paragraph 7, lines 53-65, and paragraph 4, line 63 to paragraph 6, line 13 in Ando.

Turning back to the presently claimed invention, alignment is performed for a pattern through patterning such as etching by using the mask pattern that is formed by exposure in each layer and further by development. Moreover, the alignment shift is suppressed by the effect of diffraction of light between the alignment mark used in overlaying and the intended pattern to form the semiconductor device at exposure. In order to suppress the shift, the presently claimed invention provides the alignment mark having the same line width as the intended pattern. Hence, the present invention is also clearly distinguished over Ando.

To sum up, conventionally, the alignment of the patterns has been little affected by diffraction of light. However, as the intended pattern is reduced, there is need to suppress the

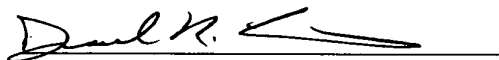
alignment shift by diffraction of light. Neither Hwang nor Ando discloses any alignment mark having the same line width as the intended pattern, and therefore it is not possible to suppress the shift by making the effect of diffraction of light same.

For the aforementioned reasons, the presently claimed invention distinguishes over the cited prior art references.

In view of the amendments and arguments set forth above, Applicant respectfully requests reconsideration and withdrawal of all the pending rejections.

While the present application is now believed to be in condition for allowance, should the Examiner find some issue to remain unresolved, or should any new issues arise, which could be eliminated through discussions with Applicant's representative, then the Examiner is invited to contact the undersigned by telephone in order that the further prosecution of this application can thereby be expedited.

Respectfully submitted,


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